

following elements, the second set being the result of the corrected value for the ratio of the curvate distances at the extreme observations, though the representation of the middle place is not sensibly improved thereby:—

Perihelion passage, Sept. 24 ^h 2778 G.M.T.		Sept. 24 ^h 0912
Long. of perihelion	... 234 42'6"	232 21'5"
" ascending node	... 350 2'4"	354 50'9"
Inclination	... 29 11'5"	29 41'9"
Log. perihelion distance	... 8.11394	8.26678
Motion—retrograde.		Retrograde.

The general resemblance of these elements to those of the great comet, will excite remark. The middle observation shows a difference from computation of $-6'2''$ in right ascension, and $-3'2''$ in declination by the second orbit; perhaps unavoidable error in an estimated place, or vagueness of the nebulousity may account for the differences, yet Dr. Schmidt speaks of having observed "Die Positionen des eines Kernes des seitlichen Nebels." Further, it may be observed that the orbit in which the great comet is now moving does not accord with the positions given by Dr. Schmidt: thus with the last elements published in NATURE, the observed and computed right ascension on October 9 will agree if the perihelion passage be assumed to have occurred September 13^h 732, but the calculated declination is north of that observed by $1^{\circ} 39'$, and for the observation on October 11, the calculation is in error $+1^{\circ} 56'$ in right ascension and $+2^{\circ} 31'$ in declination. Nevertheless the general similarity in the arrangement of the elements suggests a past connection of the two bodies, and it may be hoped that further light will be thrown upon the question, if either earlier or later observations of Dr. Schmidt's object are forthcoming.

COMET 1882 *b*.—In an unusually clear sky for the season on the morning of October 23, a fine view of this comet was obtained in the vicinity of London; the length of the more definite portion of the tail was about $16\frac{1}{2}^{\circ}$. At 5 a.m. on October 30, with strong moonlight and a somewhat vaporous sky, it was still conspicuous, notwithstanding the material diminution in the theoretical intensity of light. If the tail extended in the same direction from the nucleus on both dates, there was a large increase in its real dimensions in the course of the week. In fact, on October 30, if we assume the tail to have been a prolongation of the radius-vector, it would cover a space considerably greater than the mean distance of the earth from the sun, and with any reasonable assumption as to deviation from that line, its true length could hardly have been less than 70,000,000 miles.

The place given by M. Cruis for the comet he found at Rio Janeiro on September 12 a.m., differs $5^{\circ} 43'$ in right ascension, and $1^{\circ} 25'$ in declination from that occupied by the great comet at the time.

From an observation at the Collegio Romano, in Rome, on the morning of October 25, kindly communicated by Prof. Millosevich, it appears that the elements last published in this column were in error $-2'4''$ in right ascension and $-0'3''$ in declination, small differences, considering that the last observation used in their determination was made on October 1, and a proof of the precision of the observations issued from the Collegio Romano.

GEOGRAPHICAL NOTES

THE Council of the Geographical Society have made the final arrangements for their new African expedition under Mr. Joseph Thomson. Mr. Thomson hopes to leave England in the end of November for Zanzibar, where he will stay some months getting together his retinue and goods, and making other provisions for his hazardous journey. He will probably leave the coast in April or May next. The field of the new expedition lies to the east and north-east of Lake Victoria Nyanza, and may include a running survey of the eastern shore of the lake. The expedition will probably start from Pangani, and ascend the river of that name as far as Kilima Nyaro, whence they will proceed direct to Victoria Nyanza. The route after that will depend much on circumstances, but Mr. Thomson hopes to visit the reputed Lakes Babringo and Samburu, as also Mount Kenia. Probably Mounts Kenia and Kilima Nyaro will be more carefully examined than they have been, and beyond them the country to be traversed by the expedition is almost totally unexplored. On its borders we

meet with the names of such travellers as Denhardt, Krapf, New, Wakefield; but the field is practically virgin. A great part of the region is a wilderness, rendered so by roving Masai, whose depredations have scattered the population and rendered culture impossible. Besides the danger from these roving freebooters, the expedition will be compelled to carry its own provisions to a large extent, as there is no likelihood of getting a regular supply on the spot. Water, too, it is feared, will be scarce, so that on the whole Mr. Thomson will have a trying task before him. The expedition will be purely geographical, but it is almost certain that a naturalist will accompany Mr. Thomson as far as Kilima Nyaro, partly at the expense of the British Association. Mr. Thomson will, however, be in no way responsible for the safety or the conduct of the naturalist's party. It is probable that Dr. Aitchison, who did good work in natural history during the Afghan war, will be selected for this work, and his retinue and all his arrangements will be quite independent of those of Mr. Thomson; the two parties will simply go together so far as their route is in common.

MR. STANLEY has published separately a full report of the address he recently gave in Paris. From this we glean one interesting item of exploration. After he had launched his steamer on the upper waters of the Congo, above the cataracts, he proceeded up the river and entered the Kwango, the great southern tributary. One hundred miles from its mouth he came to where two large streams united to form the main river; a greyish-white stream from south by east, the other, of an inky colour, from east by south. Ascending the latter, much less rapid than the former, Mr. Stanley came, after steaming another 120 miles, to a large lake, into which the river widened. On circumnavigating it, he found it about seventy miles in length, and with a breadth varying from six to thirty-eight miles. The natives he found very wild, and naturally astonished at the puffing monster. A splendid country the shore seemed to be—dense, impenetrable—lofty forests, alternating with undulating grass lands. Mr. Stanley was altogether three years away from Vivi, and doubtless he has collected much information in the country around the Congo. If the five stations established on the banks—one at the mouth of the Kwango—are left unexplored, much material of value to science may be collected; they are superintended by Europeans, who have all the apparatus for taking meteorological and other observations.

ON Sunday, October 29, the Paris Society of Topography distributed its medals in the large Hall of the Sorbonne. M. de Lesseps was in the chair. The three great medals were awarded to M. D. Brazza, M. Roudaire, and Commander Perier. One of the others to M. Triboulet, treasurer of the Academy of Aërostation Météorologique, for his continuous efforts in aerial photography and the success obtained nineteen days ago in photographing the horizon visible from a captive balloon, with an apparatus put in operation from the ground.

AT the last meeting of the Section of Physical Geography of the Russian Geographical Society, M. Grigorief made a report on the results of Arctic exploration during last summer; W. E. Fuss read a communication on his visit to Novaya Zemlya, which was made to determine accurately the position of the new meteorological station; and M. Rykatcheff a communication on meteorological observations he made during an ascent in a balloon.

THE students of the Physical and Mathematical Faculty of St. Petersburg have presented M. Miklukho Maclay with an address of thanks for his valuable researches, and express the wish that the results may soon be given to the world.

A RECENT issue of the *North China Herald*, published at Shanghai, contains an article on a Chinese work entitled "Travels in India." The work is of interest as exhibiting the impression made on an intelligent Chinese traveller by the results of Western civilisation. The author, Huang Mao-ts'ai, is, it appears, a literary graduate of Kiangsi, who became impressed with the importance to China of knowing what is going on in neighbouring countries, and accordingly obtained, in 1878, a commission from the Governor of Szechuen to pass through Thibet to India. Arriving at Patang he was deterred by the hostility of the hill tribes from proceeding further in that direction, and he therefore retraced his steps, turning southward into Yunnan, whence he crossed into Burmah, and descending the Irawaddy to Rangoon, he took passage for Calcutta. He spent six months in India, returning to China by Singapore and Saigon.

His four volumes and maps were laid before the throne, and he was rewarded with an appointment in Yunnan. Around China he sees on all hands powerful and aggressive neighbours. To the ambitious schemes of these powerful neighbours and the means of checking them he devotes many pages. He dreams even of conquest, and suggests that by encouraging emigration to the southern seas, establishing consuls to look after the emigrants, opening schools to enlighten them in foreign science, and at the same time keeping up the knowledge of their native language, the great islands of that region could be made to fall like ripe fruit into the lap of China. In the territorial acquisitions of other countries Mr. Huang finds three degrees of villainy, which he describes respectively as "stealthily beguiling," "encroaching by degrees," and finally "swallowing up." Notwithstanding the offensive discrimination of these terms, he exhibits a high appreciation of English rule in India. In the latter country, he says, there are no idle officers; each has his sphere, into which no other intrudes. The will of each high functionary is limited by his council. Salaries are sufficiently liberal to prevent extortion. All are animated by a regard for their own good name. The law is faithfully executed and public spirit prompts to efforts for the general good. He is struck by the magnificence of Calcutta and its great public works. On the subject of taxes, he says: "The ground is taxed, houses are taxed, shop-signs are taxed, all manner of beasts are taxed, all handicrafts are taxed, and even fire and water are taxed. There are other taxes more than I can mention; yet you do not hear one murmuring word from the people. Why is this? It is owing to two causes: Firstly, they regard the humane Government of the English as a great improvement on the oppressive cruelty of their native rulers; and secondly, they are aware that the revenue thus collected is expended for the good of the country—in making roads, founding schools, and so on." The author is so impressed by the railway system of India that he is extravagant in his advocacy of something similar in China. He wants a railway from the north-western frontier of China proper into Li, as the only means of retaining that province and Kashgaria. In reply to objections on the score of the enormous expense of this undertaking, he exclaims with true Chinese vanity: "What other countries can do, China can do, as she is ten times richer, and a hundred times more populous."

NOTICE OF SOME DISCOVERIES RECENTLY MADE IN CARBONIFEROUS VERTEBRATE PALÆONTOLOGY

IN the course of my work upon the carboniferous rocks of the neighbourhood of Edinburgh, I have succeeded in obtaining several specimens which throw some additional light upon the little known Selachians of the Palæozoic age. It was considered a great step in advance when Prof. Kner, in Germany, and Sir P. Egerton in England, proved that the spine of the tooth known as *Diplodus*, which occurs frequently in Carboniferous rocks, was the equally well-known *Pleuracanthus*, a genus of not infrequent occurrence in the same beds. A very interesting slab from the ironstone of Burghdee, near Edinburgh, in the Carboniferous Limestone series, advances our knowledge another important stage. Upon it there are several teeth of the species *Diplodus parvulus*, Traq., associated with cranial cartilage, and a spine which is certainly not *Pleuracanthus*, but is totally unlike it, and one which does not appear to have been ever described. Upon showing it to my friend, Dr. Traquair, he said it confirmed an opinion at which he had long since arrived, that the *Diplodus* tooth would be found common to several genera of Selachian fishes. It certainly was a singular fact, and one which must have struck those palæontologists who have most carefully examined the fish-faunas of particular beds and horizons, that the number of the species of spines usually exceed those of teeth. Another important conclusion may be drawn from this discovery, viz. that spines are of very little value in relation to the affinities of sharks. Nothing can be more different than the spine of *Pleuracanthus* and that of *Diplodus parvulus*, Traq.

These conclusions are supported by another specimen in a nodule obtained from a much lower horizon, viz. on that of the Wardic Shales at Hailes Quarry, near Edinburgh. Here we have a *Hybodont* tooth associated with the spine known as *Tristychius*. The tooth, indeed, cannot be distinguished from *Hybodus*; it is deeply furrowed as in many of the Mesozoic species, and has the two depressed lateral cusps. This form of tooth is

very persistent, extending from the Lower Carboniferous to the Chalk. Gerner was the first, I think, to point out the existence of a *Hybodont* tooth in rocks of Carboniferous age, but (though I have not yet carefully examined his figures and description) the spines appear to be different from those I find associated with the Hailes specimen, though they appear to me to be of the same general type. That a *Tristychine* spine, with its smooth surface and strongly arcuate shape, should be associated with a *Hybodus* tooth is certainly unexpected, and shows again the necessity of caution in dealing with spines, for the Mesozoic spines associated with *Hybodus* are very different from *Tristychius*. *Hybodus* and *Diplodus* are therefore generalised forms of teeth associated with spines known as *Tristychius*, *Pleuracanthus*, with one undescribed genus, probably with many others. Messrs. Hancock and Atthey, to whom British science is indebted for some of the most important ichthyological observations made since Agassiz' time suggested the possibility of *Cladodus* being the tooth of *Gyracanthus*. I have seen nothing to confirm or refute this suggestion. They also referred certain small tooth-like bodies with success to the dermal skeleton of that genus. I have obtained a nodule from the Wardic shales, which has these in a remarkably good state of preservation in connection with a large fragment of the fin of that powerful shark. These dermal denticles are so closely approximated to each other that they form a dense covering, through which however appear distinctly traces of the skeleton of the fin. The occurrence of the genus at so low a horizon is of itself deserving of record, and in addition to this fragment, I have found imperfectly preserved specimens of spines of the same genus at the same place.

The remains of Labyrinthodonts are exceedingly scarce below the Burdichoun horizon. I am not aware of more than one having been discovered, and that proves to be *Ophiderpeton*, or a closely allied genus. This specimen was discovered in the Wardic shales, low down in the Calciferous sandstone series. The position of the Wardic shales in the Carboniferous series has not yet been exactly defined. Owing to the confused nature of the rocks, and the fact that they are so deeply covered with drift in a good deal of the Edinburgh area, it has not been found possible to settle quite clearly the relative position of the different members of the Carboniferous series. Nevertheless the opinion appears to be universal that the shales along the shore between Seafeld and Granton are very low in the Carboniferous system. All that I have seen confirms this conclusion. I was amused, indeed, to see them in an otherwise well got up map, lately published, coloured as the Millstone grit! Antiquated, surely! The fossils are generally identifiable with those which are everywhere found to underlie the marine limestones (in the Scotch beds, at any rate), and from all that the drift will let one see, there must be several thousands of feet of such rocks with the Wardic and Granton beds near the base. This being so, the occurrence of this vertebrate so low down is of interest and importance, and helps to confirm Prof. Fritsch's view, arrived at in his case from anatomical considerations, that *Ophiderpeton* and its allies are the roots of the Amphibian genetic tree.

T. STOCK

A NUMERICAL ESTIMATE OF THE RIGIDITY OF THE EARTH¹

ABOUT fifteen years ago Sir William Thomson pointed out that, however it be constituted, the body of the earth must of necessity yield to the tidal forces due to the attraction of the sun and moon, and he discussed the rigidity of the earth on the hypothesis that it is an elastic body.

If the solid earth were to yield as much as a perfect fluid to these forces, the tides in an ocean on its surface would necessarily be evanescent, and if the yielding be of smaller amount, but still sensible, there must be a sensible reduction in the height of the oceanic tides.

Sir William Thomson appealed to the universal existence of oceanic tides of considerable height as a proof that the earth, as a whole, possesses a high degree of rigidity, and maintained that the previously received geological hypothesis of a fluid interior was untenable. At the same time he suggested that careful observation would afford a means of arriving at a numerical estimate of the average modulus of the rigidity of the earth's mass as a whole. The semi-diurnal and diurnal tides present phenomena of such complexity, that it is quite beyond the power

¹ Paper read by G. H. Darwin, F.R.S., at the British Association Southampton meeting.